IoT Based Smart Object Detector: A Survey

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ABSTRACT

The survey addresses how an IOT smart device helps Object detection, tracking, and recognition recently have been amongst the most interesting topics for research in computer vision and its application.Object tracking is a computer vision technique used to locate and follow objects of interest in a video stream. The goal of object tracking is to track the movement of the object through the frames of the video, even if the object undergoes changes in size, orientation, or illumination. Object tracking has applications in various fields, including security surveillance, traffic monitoring, sports analysis, and robotics.Object trackers use a variety of techniques, including feature-based tracking, appearance-based tracking, and motion-based tracking. Feature-based tracking involves detecting key features of the object and using them to track its movement. Appearance-based tracking involves creating a model of the object's appearance and using it to identify the object in subsequent frames. Motion-based tracking involves using the object's motion information to track its movement. There are several challenges in object tracking, including occlusion, motion blur, and changes in lighting conditions. To address these challenges, object trackers often use a combination of techniques and algorithms, including filtering, prediction, and data association. Deep learning-based approaches, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs), have also shown promising results in object tracking. This survey may help to track and monitor the objects.In this paper initially the introduction is given, next to it the elaboration of some papers related to the topic are explained and so on followed by the conclusion.

Keywords: Object Tracking, Object Detection, Motion blur, Security surveillance

1. INTRODUCTION

Technology has revolutionized many aspects of our daily lives, including how we shop. However, waiting in long queues at supermarkets during busy times can be a frustrating experience. To address this issue, a new system is proposed that uses the Internet of Things (IoT) to create a Smart Shopping Cart.The Smart Shopping Cart uses RFID sensors to communicate wirelessly with a mobile application, allowing customers to manage their shopping list and view product information easily. This information is then sent wirelessly to the server, which automatically generates the billing for the customer.By using this system, customers can save time and avoid long queues at supermarkets. The proposed system is also competitive as compared to other solutions, and it can be easily implemented and tested on a commercial scale in the future. Overall, this new technology has the potential to improve the shopping experience for customers and address the quality of service issues that supermarkets face during busy times.

It explores the key steps involved in video analysis, specifically the detection and tracking of moving objects of interest. IT reviews the different object shape representations that are commonly used for tracking and discusses the criteria for feature selection. It also compares and analyses various approaches to object detection and tracking.Videos are made up of sequences of images called frames, which are displayed rapidly enough to create the illusion of motion. All image processing techniques can be applied to individual frames, and the contents of consecutive frames are typically closely related. The visual content of a video can be modelas a hierarchy of abstractions, starting with raw pixels and progressing to higher levels of interpretation involving objects and their attributes.Object detection in videos involves verifying the presence of an object and possibly locating it precisely for recognition. Object tracking monitors an object's spatial and temporal changes during a video sequence, including its presence, position, size, and shape. The temporal correspondence problem, which involves matching the target region in successive frames of a sequence of images, is key to solving the tracking problem. Object detection and tracking are closely related processes because tracking often starts with detecting objects, and detecting an object repeatedly in subsequent image sequences can help and verify tracking.

It proposed a method for recognizing and tracking the moving objects using camera in complex scenes.In which object recognition can be done using feature extraction, learning visual vocabulary, feature quantization and image representation. Each cluster centres of complex scenes are taken as representation for each part.

This examines the important steps involved in video analysis, specifically the detection and tracking of moving objects of interest. This provides a review of the different methods used to represent the shape of objects for tracking purposes, and discusses the criteria for selecting features to be used in tracking. This also compares and analyses various approaches to object detection and tracking.

It describes using Hybrid approach of Particle Filter and camshift for motion detection in video surveillance.Particle Filter for object tracking and camshift for object position and size estimation.Improves system robustness in challenging scenarios like

illumination changes and occlusion Outperforms existing methods in terms of accuracy and robustness, according to experimental results

Image Segmentation is an important tool for image analysis. This paper explores different probabilistic approaches to image segmentation and presents an experimental study using the K-Means clustering algorithm. The study includes evaluation of image quality metrics and a summary of the segmented model's distinguishing features.

The algorithms like camshift is used as an for object tracking based on colour histogram. However, its performance can suffer in cases where the colour distribution changes or there is object occlusion and complex background colour. In this paper, we propose an extended camshift algorithm that utilizes a Bayesian approach to estimate the colour probability density function for tracking coloured signs. The effectiveness of the approach is demonstrated by detecting and extracting visual sign images with different colour attributes. The results show that the extended camshift algorithm can detect and track coloured signs based on the identified colour class.

This study also describes the development and implementation of a smart shopping basket based on IoT applications. The aim of the smart shopping basket is to improve the shopping experience by providing real-time product information, personalized recommendations, and a seamless checkout process. The basket is equipped with various sensors and RFID (Radio Frequency Identification) technology to track the products being added to the basket and their quantities. The data collected from the sensors is sent to a cloud-based system, where it is processed and analysed using machine learning algorithms to provide personalized recommendations to the user.

This work presents a real-time system for detecting and tracking facial features in video sequences, which can be used in various visual communication applications. A skin-color model is used to segment face-candidate regions, and an eye detector verifies the presence of a face in each region. Facial features such as pupils, nostrils, and lip corners are located and tracked in real-time.

2. SURVEY CARRIED OUT

The Internet of Things (IoT) based Smart Shopping Cart is proposed which consists of Radio Frequency Identification (RFID) sensors, Arduino microcontroller, Bluetooth module,and Mobile application. RFID sensors depend on wireless communication. RFID helps in connecting RFID reader to the terminal of Internet, the readers can identify, track and monitor the objects attached with tags globally, automatically, and in real time, if needed.This is the so-called Internet of Things (IoT). RFID is often seen as a prerequisite for the IoT.One part is the RFID tag attached to each product and the other is RFID reader that reads the product information efficiently. After this, each product information shows in the Mobile application. The customer easily manages the shopping list in Mobile application according to preferences. Then shopping information sends to the server wirelessly and automatically generates billing. This experimental prototype is designed to eliminate time-consuming shopping process and quality of services issues. The proposed system can easily be implemented and tested at a commercial scale under the real scenario in the future. That is why the proposed model is more competitive as compared to others according to [1].The fig.1 depicts the architecture design of RFID.The design includes hardware components such as RFID readers, antennas, and tags, as well as software components such as middleware and cloud-based systems. It discusses the challenges faced in the design of such systems, including tag collision, tag read accuracy, and data security.The performance of the system is evaluated through experiments, and the results show that the proposed architecture can improve the efficiency and accuracy of smart shopping systems.

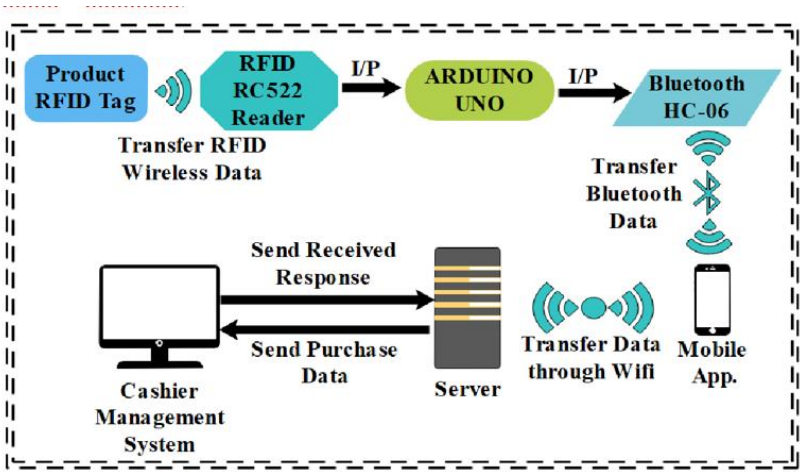

Fig.1: Architecture Design

The fig 2. Elaborates aboutthe flow diagram of the login process for a customer in an Android mobile application of a smart shopping cart typically involves the following steps:

- The customer opens the mobile application on their smartphone.
- The application prompts the user to enter their login credentials, which usually consist of a username and password.

- The user enters their login credentials, and the application verifies them against a database of registered users.
- If the login credentials are valid, the application allows the user to access their account information and begin shopping.
- If the login credentials are invalid, the application displays an error message and prompts the user to try again.
- Once the user is logged in, they can add items to their shopping cart by scanning the RFID tags attached to the products in the store.
- The application keeps track of the items added to the cart and calculates the total cost of the items.
- When the customer is finished shopping, they can checkout by using the mobile application to pay for their items using a digital payment method.

Overall, the login process for a smart shopping cart mobile application is designed to be user-friendly and secure, with multiple layers of authentication to protect the user's personal information and prevent unauthorized access to their account.

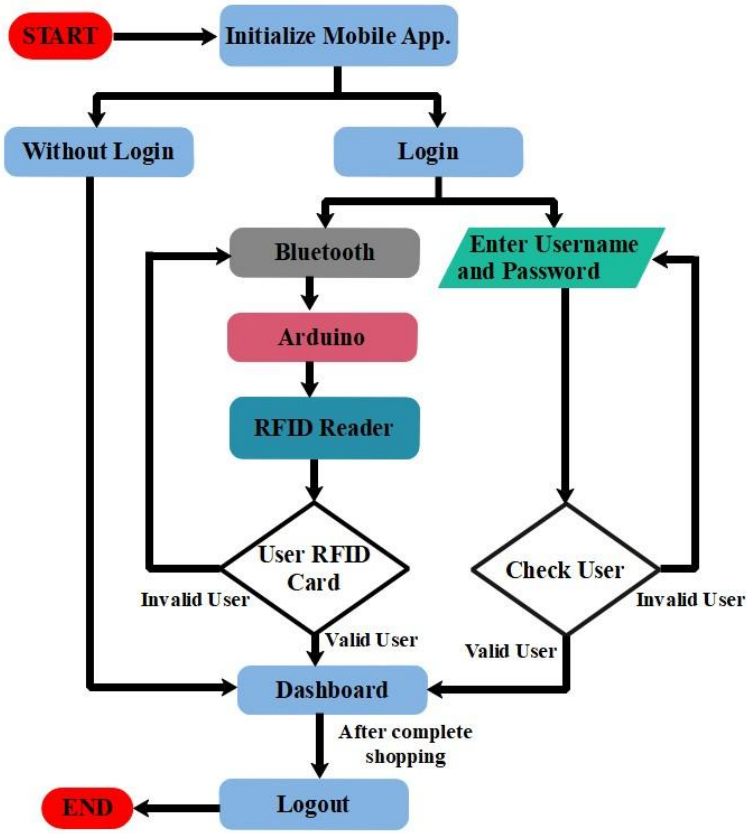

Fig.2: Flow diagram of login process of customer into android mobile application of smart shopping cart.

In this [2] used an algorithm for semi-automatic object tracking in video sequences using several features and a new probabilistic relaxation method. Although the results presented can be improved with more sophisticated methods, but used a simple method together with MVPD is able to track objects in long sequences producing smooth and accurate borders. More stress is given to the fact that even though the proposed method is a region-based one and no constraints are imposed to the boundary of the tracked regions, the borders are smooth. Here we always make use of the motion feature for the update of position. The accuracy of the borders of the tracked objects depends on the power of discrimination of the selected features, and the appearance of new objects and/or background. The algorithm does not consider the latest case in order to overcome some of these limitations, planned to use sakes or other methods to further improve the results. The tracked objects in the examples are almost rigid objects. For the case of non-rigid object the motion estimation must be improved to track the deformations of the object. The solution could be to apply the same motion estimation on a region basis. For example, dividing the object in small regions and then applying a grouping principle.

In this [3] the fig.3 describes the histogram representation of an object,is a technique commonly used in computer vision to recognize and track objects in complex scenes. The basic idea behind histogram representation is to create a statistical model of an object's appearance in an image.The process involves selecting a region of interest around the object in the image, and then computing a histogram of the colour or texture features within that region. This histogram can then be used as a template to match against other regions in subsequent frames of the video, allowing the object to be tracked as it moves.

There are various techniques for computing histograms, such as colour histograms, texture histograms, and shape histograms. Colour histograms use the distribution of colours within the region of interest to create a model of the object's appearance. Texture

histograms, on the other hand, use the distribution of texture features, such as edge orientations or spatial frequencies, to create a model. Shape histograms use the shape of the object as a basis for creating the model.
Histogram representation is a powerful tool for object recognition and tracking in complex scenes, as it allows for robust tracking even when the object undergoes changes in appearance due to lighting conditions or occlusion by other objects in the scene. It has been used in a wide range of applications, such as surveillance systems, robotics, and autonomous vehicles.
Feature Extraction refers to the process of transforming raw data in numerical features that can be processed while preserving the information in the original data set.

Quantization refers to mapping continuous infinite values to a smaller set of discrete finite values.

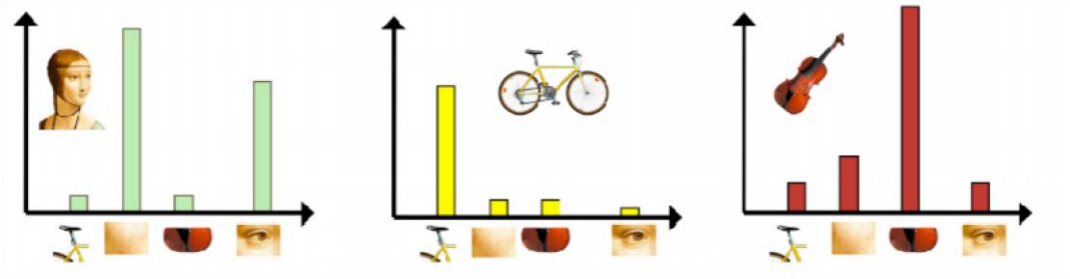

Fig.3: Histogram Representation of Object

[4] gives the brief description about Colour Image segmentation, which is an important and difficult task in processing many image, video and computer vision applications. It is one of the key tools for image analysis segmentation has become the important objective in image analysis that uses the most common image feature such as intensity, colour, texture, etc. In this much work has been studied based on statistical and structural method for image analysis for grayscale images. The statistical method makes use of the probability distribution function of pixels and regions to characterize the image and the structural, which analyse the image in terms of organization and relationship of pixels and regions by specified relations.

For Colour image segmentation, there are many technologies available among which clustering is widely used. In different clustering algorithms has been discussed and classified into four types Hard Clustering Fuzzy Clustering, Hierarchical Clustering and Probabilistic Clustering.

This[4] presents an image segmentation approach using K-Means clustering technique based onintensity and colour feature, In K-Means to calculate the distance between each point of the dataset 10 everycentroid initialized. Made use of City Block distance metrics from the different technique available such asEuclidean distance, City Block distance (Manhattan), Cosine distance and Correlation distance. To obtain the number of image regions K, hierarchical clustering has been used. After that we go through experiment for implementing K-Means algorithm in mat-lab. The performance of the segmented algorithm is evaluated by computing the Image Quality Metrics.

In this [5] discussed about an approach to define the existence of moving object in the video frames and to keep the track of an object's motion and positioning. A static camera is used to grab the video. Video is actually sequence of images which are known as frames. We can identify the object using different algorithms and tracking can be defined by using different filters. Object detection and tracking can be classified using different properties of that object like colour, size, texture, optical flow, edges position, shape, distance etc. Detected object can be of various categories such as humans, vehicles, birds, moving ball and other moving objects. Object tracking is used in several applications such as video surveillance, person identification, robot vision, behaviour analysis, security, traffic monitoring, image retrieval, face detection, animation etc. This survey paper basically defines a brief survey of different object detection and tracking techniques using different algorithms. Fig 4 represents the taxonomy of image tracking used in this [5].

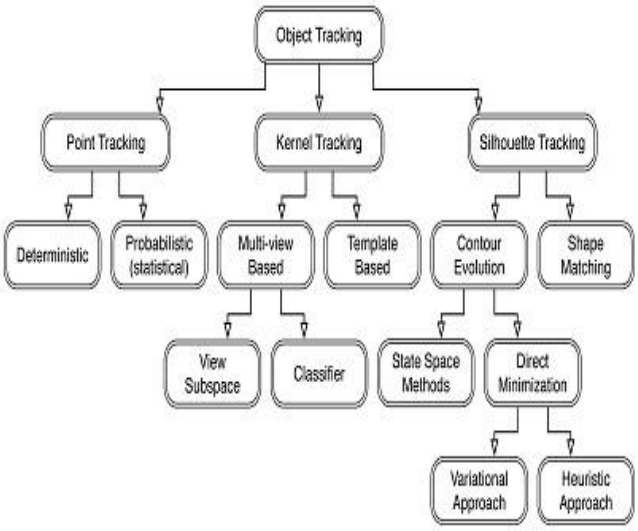

Fig.4: Taxonomy of Tracking Image

The [6]Object detection and tracking are two important processes in computer vision that involve identifying objects and their movements in images and videos. Object detection involves searching for specific objects within an image or video, while motion detection involves detecting changes in an object's position or its surrounding environment. Both visual features, such as color and texture, and motion information can be used to assist in object detection and tracking. These processes have various applications, including surveillance and monitoring, object avoidance, and video conferencing. The first step in tracking an object is to detect it within each frame of the video.

Particle Filter Algorithm

The Particle Filter algorithm is a method used for tracking objects in video frames and detecting motion. It involves placing a color particle on the object and focusing on the color particles within the detected foreground object. The Particle Filter algorithm has an advantage over other filters, such as Kalman Filter and Extended Kalman Filter, in that it can represent any distribution in a state space. It can also handle non-linear and non-Gaussian models and processes. The Particle Filter algorithm is particularly useful in tracking single or multiple objects.

CAMSHIFT Algorithm

Continuously Adaptive MeanShiftis an important algorithm for motion detection based on the color histogram. The CAMShift algorithm works by finding the mode of a probability distribution map within a search window and it iteratively updates the position and size of the window until the convergence is met. The algorithm boasts of high performance in a simple environment where the color distribution is constant. CAMShift algorithm is frequently used for object tracking in video surveillance, which has a good realtime performance. Firstly, the moving object can be obtained by background subtraction and frame differences method, then the location of extracted moving target will be taken as the initial search window for the CAMShift algorithm, and finally the automatic tracking of the moving target can be realized.

The CAMShift algorithm can be summarized in the following steps:

1. Initialize the search window.
2. Calculate the color probability distribution of the search window (back projection).
3. Run Meanshift algorithm, obtain the new size and position of the search window.
4. Re-initialize the size and position of the search window in the next frame of video image by using the value that calculated in step (3), and jump to step (2) to proceed.

In this [7] overview paper utilized procedure called as Continuously Adaptive MeanShift (Cam Shift),is an critical calculation for question following based on the colour histogram. The calculation works by finding the mode of a likelihood conveyance outline inside a look window and iteratively upgrades the position and measure of the window until merging. The calculation brags of tall execution in a straightforward environment where the colour dissemination is consistent. In any case, since the calculation is subordinate on a inactive colour dispersion, its execution endures in cases where the dissemination changes e.g. due to brightening or climate conditions. In expansion, question impediment and complex foundation colour can corrupt the execution of the calculation. In this paper, we propose a Cam shift calculation that can track coloured signs. Since different colours are included for following, we utilized a Bayesian approach to assess the colour likelihood thickness work.This density function gives the likelihood of whether a pixel esteem compares to certain protest. We outline the viability of our approach by recognizing and extricating visual sign pictures with diverse colour properties. The result gotten appears that our amplified Cam Shift calculation can identify and track coloured signs based on the recognized colour course.

This [8] briefs about the IOT application, Each day, tremendous numbers of clients come to purchase various merchandise at general stores around the world. These days, customers utilize a shopping cart or bushel when buying the basic supplies at a grocery store. In expansion, the obtainment of items includes a complicated handle in which the clients must bring the things they need to buy to the check-out region, at that point stand and hold up in a long line so that the items can be checked, the entire sum calculated and the charge paid. As a result of this issue, this inquire about ponder presents the improvement of a keen bushel for shopping. A standardized tag is found on each thing in a general store, and the keen wicker container will incorporate a standardized identification peruser on a versatile gadget. While shopping, customers can check the products and after that put them within the bushel, and the versatile gadget will record and show the cost and title of each thing.Moreover, the wicker container will have a weight sensor framework that can affirm the precise estimating of deliver amid the shopping handle. Calculation of the entire taken a toll of the customer's groceries will be performed and put away within the memory of the keen basket's microcontroller. This information will be sent from the wicker container to the most computer's server through a transmitter. Subsequently, the proposed shrewd wicker container will permit customers to maintain a strategic distance from waiting in line and having to always think almost the sum of cash they will ought to spend.

In [9] The Internet of Things (IoT) is a technology that enables devices and objects to be connected to each other through a network. It is a combination of hardware and software, which allows for seamless connectivity and remote access to data. The IoT architecture comprises three layers: things, gateway, and cloud, which consist of sensors, devices, and objects. The gateway and cloud are composed of edge computing and responsible for wireless communication. IoT has several characteristics, including interconnectivity, safety, heterogeneity, enormous scale, dynamic changes, and connectivity. It is classified based on its functionalities, such as things-oriented, semantic-oriented, and internet-oriented. The main aim of IoT is to provide ease of operations, remote access control, configuration, and end-user. It has been used in various real-time applications, such as smart cities, smart homes, smart energy, smart agriculture, smart industry, and smart living. IoT is evolving from machine-to-machine communication and has been successful in creating intelligent machines that can communicate with various objects and sensors to make our lives easier and safer.

This [10] is based on real time application for detecting and tracking of facial features using video sequences .Tosegment or breakdown the regions in the image a method called statistical skin colour model is used.Eye detector verifies whether the face in each region is present or absent by an efficient template matching scheme. When the face is detected all the facial features are tracked in the image sequence by performing the real time application.

This [11]study helps in background subtraction of images from statistical and temporal single camera video sequences in security systems.In static scene, the background subtraction algorithm provides solution to detect moving objects .Object detection technique consists of any video scene objects. For video surveillance system detection of object seems to be very challenging.Object tracking is used to find the area where objects are available and shape of objects in each frame in higher level application. Fig 5 illustrates
The flow diagram for object detection using background subtraction, statistical and temporal frame difference typically involves the following steps:

- Capture a video stream from a camera or other source.
- Preprocess the video frames to enhance the contrast and reduce noise.
- Extract the background image from the video stream by averaging a number of frames that represent the background without any moving objects.
- Subtract the background image from each video frame to obtain a foreground image.
- Use statistical methods to threshold the foreground image and separate the moving objects from the static background.
- Use temporal frame difference to determine the speed and direction of the moving objects.
- Apply morphological operations to remove noise and fill gaps in the detected objects.
- Use shape analysis and other feature extraction techniques to identify and classify the objects.
- Display the results in real-time or store them for later analysis.

Overall, the object detection process using background subtraction, statistical and temporal frame difference is designed to detect moving objects in a video stream and extract useful information about their speed, direction, and shape. This process is widely used in surveillance, traffic monitoring, and other applications where it is necessary to detect and track objects in real-time.

Fig.5: Flow Diagram Object Detection

[12] Describes about image and video sequences are detected and tracked. Tracking is related to object movement and appearance to overcome the issue of detection .Video sequences can be smoothened by tracking the algorithm. In case of few methods, prior use of information such as shape of object,colour of object, texture of object and soon are used.The objects which are tracked and detected using video sequences are analysed through different phases. Alsoa new approach to improve tracking of objects over video frame to identify to identify the gap. Fig 6 elucidate the basic flow diagram of object tracking typically involves the following steps:

- Input an image or video sequence containing the object to be tracked.
- Perform object detection to locate the object in the first frame.
- Extract features from the object and surrounding area, such as color, texture, and shape.
- Use these features to create a model of the object to be tracked.
- Match the model to subsequent frames in the video sequence to track the object's movement.
- Update the model periodically to adjust for changes in appearance or motion.
- Handle occlusions or other tracking errors by predicting the object's location based on its previous trajectory.
- Display the tracked object in real-time or store the tracking data for later analysis.

Object tracking can be performed using a variety of techniques, including template matching, optical flow, and feature-based tracking. The basic flow diagram outlined above can be adapted to fit different tracking algorithms and applications. Overall, the goal of object tracking is to follow the movement of an object in a video sequence and provide information about its trajectory, velocity, and other characteristics. This information can be used in a variety of applications, such as surveillance, robotics, and video editing.

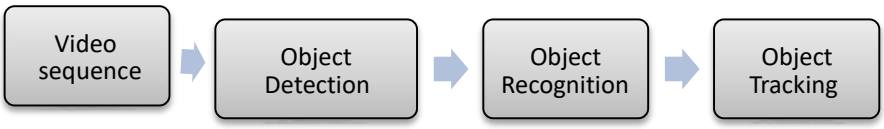

Fig.6:The Basic Flow Diagram of Object Tracking

In this survey paper we present an approach to define the existence of moving object in the video frames and to keep the track of an object's motion and positioning. A static camera is used to grab the video. Video is actually sequence of images which are known as frames. We can identify the object using different algorithms and tracking can be defined by using different filters. Object detection and tracking can be classified using different properties of that object like color, size, texture, optical flow, edges position, shape, distance etc. Detected object can be of various categories such as humans, vehicles, birds, moving ball and other moving objects.

Object tracking is used in several applications such as video surveillance, person identification, robot vision, behavior analysis, security, traffic monitoring, image retrieval, face detection, animation etc. This survey paper basically defines a brief survey of different object detection and tracking techniques using different algorithms.

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3. CONCLUSION

After reviewing the above papers, it can be concluded that there is a growing interest in developing smart systems using IoT-based technologies. Several techniques have been proposed for object detection and tracking in image and video sequences, such as background subtraction, statistical and temporal frame difference, particle filter, and CAMShift approach. These techniques have shown to be effective for different applications such as shopping cart automation, facial feature detection, and recognition, and moving object tracking in complex scenes. Additionally, K-means clustering algorithm has been proposed for image segmentation, which improves the quality of image segmentation.

Overall, these papers suggest that IoT-based smart systems have the potential to revolutionize various industries by providing efficient and automated solutions for complex tasks. Object detection and tracking techniques are crucial components of these systems, and research in this area is ongoing. Future work should focus on developing more accurate and efficient algorithms to further enhance the capabilities of these smart systems.

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